DEPARTMENT OF THE ENVIRONMENT

RAILWAY ACCIDENT

Report on the Derailment that occurred on 20th May 1970 at Audenshaw Junction near Guide Bridge

IN THE
LONDON MIDLAND REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
1971

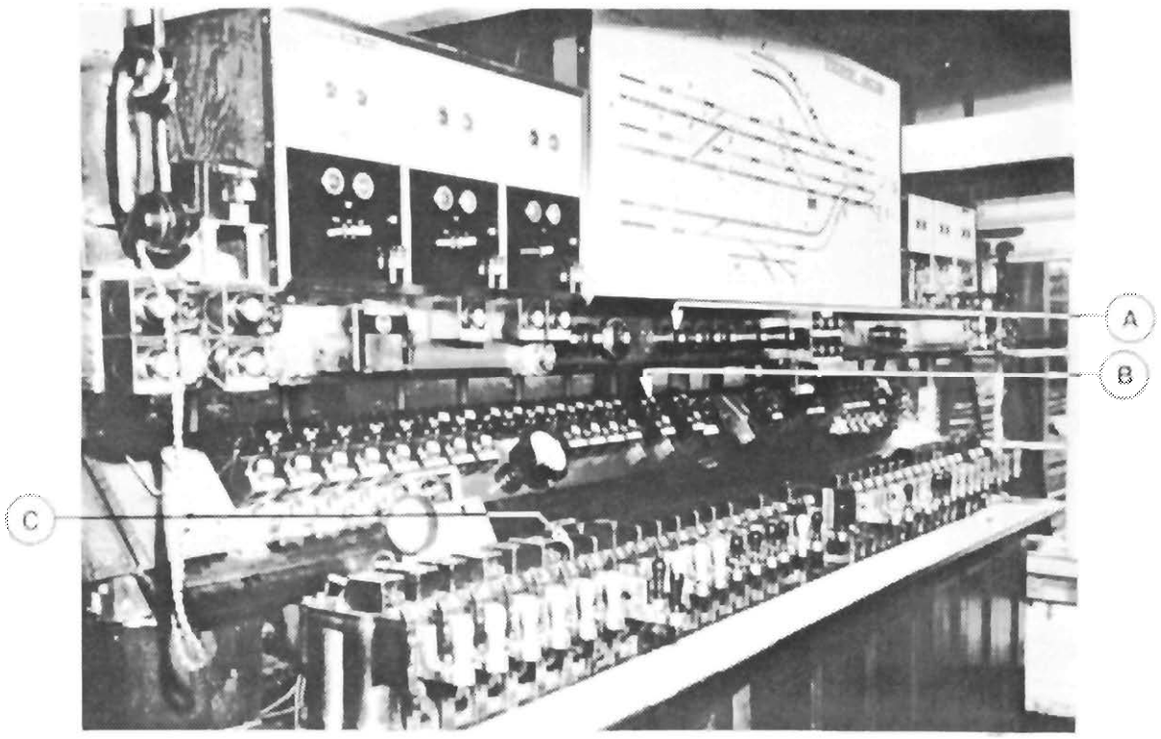


FIG.1 GENERAL VIEW OF FRAME.

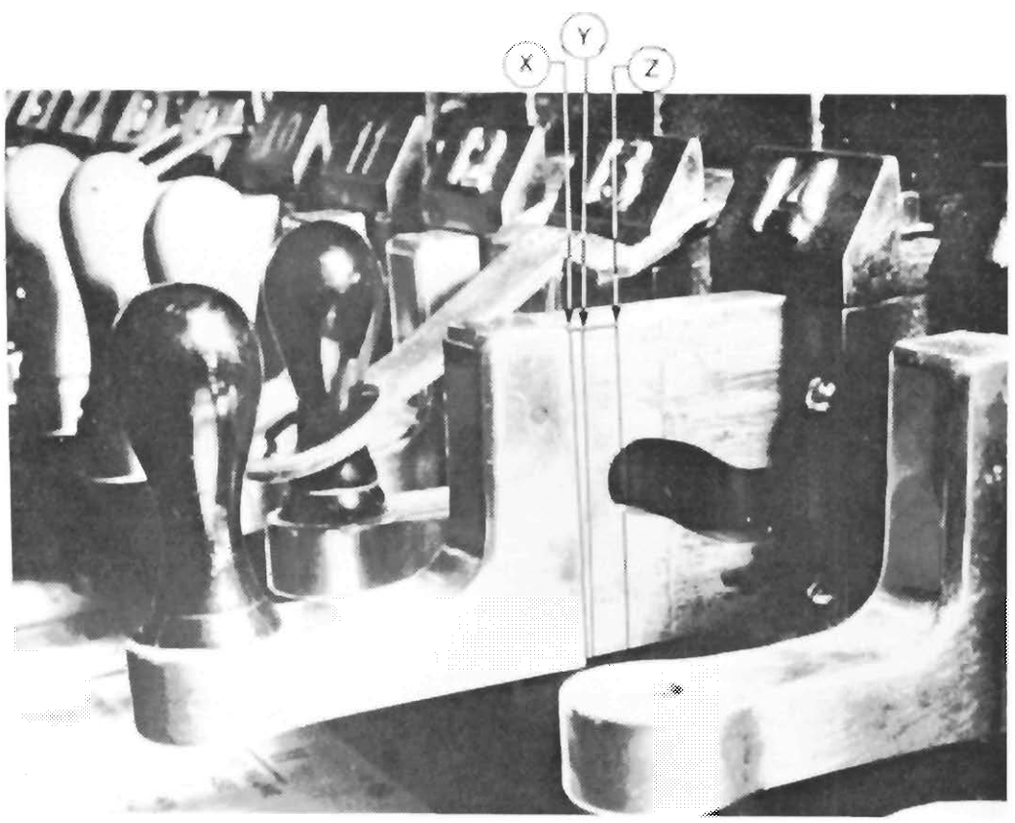


FIG.2 SLIDE No.14 (HANDLE OF No.15 REMOVED)

SHOWING POSITIONS:—

X. SLIDE FULLY NORMAL

Y. ELECTRIC LOCK EFFECTIVE

Z. MECHANICAL LOCKING EFFECTIVE

SBN 11 550212 2

DEPARTMENT OF THE ENVIRONMENT,
ST. CHRISTOPHER HOUSE,
SOUTHWARK STREET,
LONDON S.E.1.
22nd April 1971.

SIR,

I have the honour to report for the information of the Secretary of State for the Environment in accordance with the Order dated 21st May 1970, the result of my Inquiry into the derailment of an electric multiple-unit passenger train that occurred at about 22.55 on 20th May 1970, at Audenshaw Junction near Guide Bridge on the Manchester and Sheffield electrified line of the London Midland Region, British Railways.

The train was the 22.45 Manchester Piccadilly to Hadfield 3-car electric multiple-unit. It had been held at a signal on the approach to the junction, and when the signal cleared for the Up Fast line, the train started away and was travelling at between 15 and 20 m.p.h. and was over the facing points of the junction when the points moved under the train. The front car and the leading bogie of the centre car continued on the Up Fast line, but the remaining bogies took the crossover to the Up Slow line, the centre car rolling over onto its near side and being dragged along the Up and Down Slow lines until it came to rest with its roof against the Up abutment of a road over rail bridge some 88 yards from the points. The leading bogie of the third car was also derailed.

The emergency services were not called until 23.05, but the first ambulance arrived at Guide Bridge station at 23.10 and the fire brigade arrived on site at 23.17. The overhead electric power was cut off following a request by the signalman to the Controller at Manchester at 23.15, and Penistone Electric Control confirmed that it was off at 23.18. However all the passengers could not be released from the overturned car until 00.35.

I regret to report that of the 33 passengers on the train two passengers were killed and 13 injured, of whom 5 were detained in hospital.

Rerailing of the two cars was completed by 11.30 next day and overhead power was restored at 12.15 and the Up and Down Fast lines opened to traffic at 13.15. Audenshaw Junction was taken out of use and made secure and after repairs the Slow lines were brought into use at 22.35.

In my opinion the derailment was directly caused by the action of the signalman on duty in Stockport Junction signalbox at the time of the accident, who had irregularly unlocked the facing points before the arrival of the train, and having cleared the signal by a second irregularity, reversed them before the train was clear of them. No fault of any significance was found in the signalling equipment or in the condition of the track or the train.

The weather at the time of the accident was fine and clear.

The Site and Signalling

1. The Manchester-Sheffield main line via Hadfield and Penistone is electrified on the overhead system at 1500 volts DC. Audenshaw Junction as shown in Fig. 4 at the back of this report, lies between Fairfield Junction and Guide Bridge stations and is about 4½ miles from Manchester Piccadilly station. It is controlled from Stockport Junction signalbox beside the Down Fast line (Down to Manchester) at the Manchester end of Guide Bridge station. The Up and Down Slow lines lie to the north of the Up and Down Fast lines, and are connected with them through a left hand double crossover at Audenshaw some 1300 yards from the signalbox, and out of sight of it. There is a right hand double crossover by the signalbox where branch lines from Ashton Moss South and Denton Junction also connect. The gradients are 1 in 133 rising from Fairfield Junction and 1 in 364 on the approach to and over Audenshaw Junction up to the signalbox.

2. Train signalling on the passenger lines is on the Absolute Block System, with full track circuiting, the adjacent signalboxes being Fairfield Junction 1¼ miles in the Down direction and Ashton Junction ¼ mile in the Up direction. The passenger lines are equipped with 4 aspect colour light signalling. On the Up Fast line signal No. 5 protects the facing crossover points No. 14 at Audenshaw Junction and reads on the Up Fast line to signal No. 6 which protects the trailing crossover at Stockport Junction and which is some 730 yards past signal No. 5. Signal No. 5 carries an indication 1 position light junction indicator when reading through the turnout onto the Up Slow line, and Signal No. 34 on the Down Slow line is similarly equipped for reading to the Down Fast line.

The Signal Frame and Controls

3. Stockport Junction signalbox in common with ten other signalboxes in the area is equipped with an electro-pneumatic frame fitted with slides in place of levers as shown in figure 1 at the front of this report, which also shows the illuminated diagram and the block instruments each side of it. The slides have slots cut in them as shown in figure 2 in which rollers run to drive the mechanical interlocking. Point slides have press button economisers (A) mounted above them, and at a lower level illuminated normal and reverse indicators (B). Signal slides have automatic economisers known locally as 'mousetraps' which operate as a slide is pulled (C). Signal No. 5 cannot be pulled unless the slide for points No. 14 is either fully normal or fully reverse and

the lock detector contact 'made' in the normally de-energised electric lock at the back of the frame on No. 14 slide. When pulled, slide 5 locks slide No. 14 automatically. When a train occupies track circuit 7120 some 35 yards past signal No. 5, the latter's slide is automatically replaced to normal with some force, pneumatically. In a similar manner, when a points slide is replaced beyond the mid point to the 'B' position the points are operated, and when they are locked and detected normal the slide is pneumatically driven to the full normal position; and the same applies for the reverse movement. There are no normal electric locks on signal slides. So long as an air supply exists, slide No. 5 cannot be pulled unless its slide replacement magnet solenoid valve is energised through the various signal controls being clear, so that the replacement cylinder is vented to atmosphere, which in turn allows a spring to disengage a mechanical catch from the slide. In addition, to clear the signal aspects requires not only the signal controls and the slide reversed but also the lock detector contacts of the electric lock on No. 14 points slide being made up.

4. The points are air operated, controlled electrically by solenoid valves mounted on racks at the lineside. All track circuits are AC type. Track circuit 7120 which is of the single rail type (see fig. 5) begins 35 yards ahead of signal No. 5 and ends some 105 yards past No. 14a facing points. No. 14 slide cannot be pulled unless No. 7120 track circuit is unoccupied and both the track circuit relay and 14 slide electric lock thereby energised. Similarly the slide cannot be pulled unless track circuit 7127 on the Down Slow line which starts some 32 yards past signal No. 34 and some 83 yards before points No. 14B, is unoccupied. Points No. 14 are also approach locked when track circuit 7095 on the Up Fast line is occupied. This approach locking is meant to be released when the track circuit has been occupied with signal No. 5 at Danger after a period of 90 seconds from the time a treadle positioned 232 yards on the approach to them is operated. However tests after the accident showed that the timer had in fact been set at 137 seconds. The points are similarly approach locked when the track circuit 7156 on the Down Slow line which starts some 555 yards before them, is occupied and the release period in this case was correctly set at 120 seconds.

5. There is small relay room situated behind the signalbox, the door of which faces the signalbox but cannot be seen by the signalmen because of an intervening wall. 7120 Track Repeating Relay is one of the many relays in this room.

The Track

6. At the time of the accident the track in the Up Fast line on the approach to the junction which is on a slight right hand curve was in 110 A lbs flat-bottomed rail on timber sleepers laid in 1963, but the two rail lengths before the facing points and the crossover itself were in 95 lbs bull-head rail on timber sleepers with wooden keys laid in 1962. The facing connection No. 14a which moved under the train had last been hand packed in April 1970. Both the approach track and that in the crossing itself was in a fair condition.

The Train

7. The train involved was a Manchester-Glossop-Hadfield three-car Open set consisting of Driving Trailer Open Second No. M59605 leading, with Trailer Open Second No. M 59505 and Motor Open Brake Second No. M59405 in rear. The motor car was powered by four 185 h.p. GEC traction motors two on each bogie supplied through a pantograph at the driving end of the car. In this type of unit the two motors in each bogie are permanently connected in series and for the first portion of acceleration the two pairs are also connected in series together with non-inductive resistors contained in three boxes mounted for ventilating purposes on the underframe of the power car. The acceleration of these trains is entirely automatic and the driver has only to move his controller quickly into the Notch 5 (weak field) position. The automatic control cuts out the resistances until running position '3' known as "full series" is achieved, then switches the motors into parallel running with full resistances, and finally after cutting out the resistances again switches them into "weak field" for full speed. Four switches are involved, and current limit relays all of which carry full traction current.

8. The train was 178 feet overall and weighed 104 tons 16 cwt. Its wheelbase overall was 165 ft 5 in and the clear wheelbase of the central car was 38 ft 0 in. It was screw coupled with side buffers. Each car had two power operated sliding doors for passengers on each side but there was no inter-connection between cars. Moreover the central car was divided into two separate compartments for 38 second class passengers (to the front) and 24 first class passengers (to their rear), with no through door. Seats were placed both laterally and longitudinally in both, as shown in Fig. 7.

The Course of the Derailment and Damage

9. The train came to rest with the driver's cab on the Up Fast line some 120 yards beyond No. 14a facing points and the rear car on the Up Slow line some 73 yards beyond the points as shown in Fig. 3. Between them lay the middle car on its near side its bogies having become detached from it which were lying derailed on the Up Fast and Down Slow lines. There were no marks of damage on 14a switches and the first mark of derailment was on the crossover beyond the common crossing where the marks on the sleepers in the 4 foot of the crossover and the point rail of the Up Fast line were consistent with those of a bogie having been jerked sideways off the track between the common crossing and the end diamond crossing in the Down Slow line, to the offside of it in the direction of the Up Fast line. Damage to the points and crossing work beyond that point was considerable especially to the diamond crossing, and sleepers had been damaged by both the derailed bogies of the centre car as they were dragged along the Up Fast and Down Slow lines. Trailing points No. 13 were also slightly damaged and the point operating equipment beside the Up Slow line severely damaged.

10. The driving trailer which was leading suffered only minor damage to jumpers and connections but the middle car had most of its cess (near) side windows broken and there was a quantity of broken glass inside the coach which had caused injuries to the passengers who were hurt. There were also deep scars diagonally down the outside of the car caused by its having been pushed or dragged diagonally along the tracks. Many of the seats were displaced and jumper cables and couplings had been torn out. The forward end of the motor car which was in the rear was badly buckled, its jumpers and couplings were damaged and brake rigging distorted.

Evidence Concerning the Accident

11. *Driver T. Greenwood* took over the 22.45 Manchester Piccadilly-Hadfield train at about 22.44. The previous driver reported that there were no faults and the train left on time. He made a stop at Ashburys station and was next due to stop at Guide Bridge Station. He told me that before passing through Fairfield station at about 35 to 40 m.p.h. he had shut off power on seeing the Fairfield Junction Home signal No. 4 showing a Double Yellow aspect, indicating that the Stockport Junction signal No. 5 was at Danger. At no time did he see the Junction Indicator at signal No. 5 lit. He told me that he brought his train steadily to a stand and stood with his brakes off. After 15 to 30 seconds the signal cleared to Green and he put his control handle quickly into the "weak field" position and the train pulled away quite normally. Shortly afterwards and while he still had full power on, the lights went out and the brakes were fully applied. He shut off power and the train came to a sudden stand. He got out of his offside door and went back and saw the coach lying on its side. He returned to his cab to collect his detonators and then saw a freight train approaching slowly along the Down Slow line. He went towards it flashing his torch and the train came to a stand, and he then placed detonators on the Down Fast line. He told me that the driver of the freight train then went back to the signalbox to report the accident, while he went to the rear of his train to find his guard. He found that the lights were still on in the rear car and the auxiliary motors were still working so he lowered the pantograph and isolated the unit. The guard then told him that he had protected the rear of the train with a track-circuit operating clip and had telephoned the signalman from a signalpost telephone.

12. *Guard M. I. Malik* who was in charge of the train had joined it at 17.00, and was on his fourth journey at the time of the accident. He told me that the unit had been running quite normally and that they left Manchester Piccadilly on time at 22.45. He sat on the seat on the offside of the brake compartment next to the unmanned driver's compartment at the rear of the train. He told me that when they came to a stand at signal No. 5 he walked across the compartment and looked out of his nearside window and saw the signal showing a Red aspect. He said that the signal changed to Green almost immediately and he thought it was still showing Green when his cab passed it. (His seat was some 165 ft in rear of the front wheels of the front bogie, and signal No. 5 should have been replaced to Danger as these wheels crossed onto track circuit No. 7120 some 105 ft ahead of the signal. It should therefore have reverted to a Red aspect some 60 ft ahead of the guard's window).

13. He told me that soon after passing the signal he was thrown across the compartment and hit his head on the table. When they came to a stand he heard passengers in his car shouting so he opened the offside doors (which are power operated) and allowed them to detrain. He then applied the hand brake and went back to protect the rear of his train. He placed a track-circuit operating clip on the approach to signal No. 5 which was showing a Red aspect and another on the Up Slow line. He then telephoned the signalman at Stockport Junction and told him of the accident and requested the emergency services, following which he went back and placed detonators on both lines. On returning to his train after some 15 minutes he placed a red lamp at its rear and then walked up to the signalbox to make sure that the lines had been fully protected. When questioned whether he had asked the signalman to have the electricity cut off the overhead line, he said that he had not, but in a statement he made to Railway Officers shortly after the accident he said that he had asked for the electricity to be cut off when he visited the signalbox.

14. *Mrs. Edith Hargreaves* was one of the passengers travelling in the middle car, whom I visited in hospital on the day following the accident. She told me that the train had been going slowly when it began to rock and then it shuddered and a man's voice said "We can't make it, he's changing the points under us, I'm a signalman, I know". She then felt herself falling and the lights went out and later the same voice said "Don't panic anybody, stay exactly where you are, the overhead wires may still be alive". Mrs. Hargreaves was loud in her praises for the conduct of this man.

15. *Signalman A. B. Ashton* was the signalman Mrs. Hargreaves referred to and he was sitting on the left hand side at the rear of the front compartment of the middle car. He saw signal No. 5 showing a red aspect and later he saw that it was green as they moved away. He told me that the ride had been perfectly normal until then but as they passed over No. 14a facing points he heard them change under him (there were similar points close to Mottram No. 2 signalbox where he worked) and a few seconds later the car lurched left and shortly afterwards it rolled over onto its side. When I questioned him about the comment Mrs. Hargreaves had heard him make he said he could remember nothing about it. He told me that when they came to a stand he saw something he took to be a piece of rail sticking up through the broken door so he got a seat and wedged it between the rail and the metal framework of the car as a short-circuit in case the live wires touched the upper surface of the car they were in. He told me that after what seemed to be a long time firemen released them by placing ladders both outside and inside the coach so that they could escape through the offside doors which were above their heads.

16. *Driver A. Rowbottom* was driving the 16.40 Tinsley to Glazebrook freight train and joined it at Guide Bridge just after 22.00. As he approached signal No. 35 on the Down Slow line at the platform end the aspect changed from a Red to a single Yellow and he passed it at about 6 m.p.h. He then saw No. 34 signal ahead at Red, but as he approached it he saw flashes and what he took to be smoke or dust and he saw Driver Greenwood waving his handlamp whereupon he stopped his train. He told me that he then walked with Driver Greenwood up to the signalbox and shouted to the signalman from the tracks that there had been an accident. He told me that the signalman opened the window and said to them "It is all showing clear on my track", from which he assumed that all the lines had been protected.

17. *Guard G. E. Ashby* of the freight train told me that he went down to the accident after they had come to a stand and stopped some passengers trying to climb onto the top of the upturned coach because of the danger of electrocution. He later escorted passengers along the lines to Guide Bridge station.

18. *Signalman J. Walmsley* was on duty in Stockport Junction signalbox at the time of the accident. He told me that he came on duty at 21.30 and at 22.51 Ashton Junction offered him a freight train on the Down Slow line which he accepted, and at once received "Train Entering Section" for it. He said that he then set No. 14 points reverse from the Down Slow to the Down Main line. At that time there was also an EMU passenger train on the Down Fast line and No. 15 points were normal for it. At 22.54 Fairfield Junction offered him the Up Hadfield EMU train which he accepted. The Down Fast EMU train passed his box at 22.55 and he sent "Train Entering Section" to Fairfield Junction for it. He told me that at that time the first indicated track circuit on the Down Slow line on his signalbox diagram, which is that in the station platform, became illuminated although he could not actually see the freight train from his signalbox. He received "Train Entering Section" for the Up EMU train from Fairfield Junction also at 22.55 and at the same time slide No. 35 which operates the Platform Starting signal on the Down Slow line was automatically replaced as the freight train passed it. (This signal is replaced by occupation of a track circuit only a few feet past it). He then said that he replaced No. 14 points to Normal and offered the Up EMU train to Ashton Junction. He told me that he had to wait for it to be accepted but as soon as it was he gave "Train Entering Section" for it at 22.55 although it had not passed his signalbox. Having had this train accepted he pulled off Signals Nos. 5 and 6, and saw them both indicated Off on their illuminated indicators. (Signal No. 6 is Block Released from Ashton Junction). Having waited for the train to pass signal No. 5, and as the slide was automatically replaced to normal in the frame he told me that he put his left hand on the economiser button of points slide No. 14 to reverse the points for the freight train when the passenger train had cleared them. He added "you have got to be ready to hand that junction over as quickly as possible because when he (the freight train) hits the berth track (the berth track circuit to signal No. 34, No. 7156) you cannot get on the junction for a matter of 3 or even 4 minutes". He saw track circuits Nos. 7095 and 7120 both occupied when No. 5 signal slide was automatically replaced, and he said he waited for the click of the electric lock slide No. 14 being energised, and when he heard it he pulled slide No. 14 and then slide No. 15 to set the route for the freight train to cross over behind the passenger train.

19. He told me that almost immediately all the track circuits showed occupied on his illuminated diagram including Nos. 7120 and 7121 and those on the Down and Up Slow lines. He estimated the time as still being several minutes before 23.00. At 23.06 the guard of the EMU telephoned and told him of the accident and he sent "Obstruction Danger" to Fairfield Junction at 23.06 and then telephoned Manchester Piccadilly Control for the emergency services. Finally, at 23.08 he cancelled the block release for the EMU train which he had offered, and for which he had already sent "Train Entering Section" to Ashton Junction. The first person to visit the signalbox after the accident was one of the guards but he did not know his name. He confirmed that neither he nor his train recorder *Widdows* had left the signalbox at any time before or after the accident. (I have been told that at 23.15 he again telephoned the Manchester Controller for the electricity to be cut off and that this message was sent on to Penistone Electric Control immediately).

20. He had joined the Railway in 1952 in the Permanent Way Department but had been a signalman for 15 years, although he had only worked in a box with pneumatically operated slides for about twelve months. Previous to his railway service he was a pattern moulder. He said that his previous turn had been 06.00 to 14.00 and he had a rest day for Wednesday, 13th May. That turn ended on Saturday at 14.00 and his present turn began at 21.30 on the following Monday.

21. *Train Recorder G. H. Widdows* came on duty at 22.00 on the night of the accident. His seat in the signalbox faces in the Down direction so that he has his back to Guide Bridge station and the signalman is on his right and generally behind him. He corroborated his signalman's evidence concerning the times at which trains were offered and acknowledged and told me that they had received "Train Entering Section" for the Hadfield train from Fairfield Junction at 22.55. He then said that Walmsley went straight away to the Guide Bridge end of the signal frame and "sent it on to Ashton". He continued "I do not know what he did then. He went to a table for some reason, whether he poured himself a drink of tea or anything like that I do not know. When I looked round again the passenger was at number 5 signal". He told me he saw the track circuit (No. 7095) showing occupied on the signalbox diagram and Walmsley pulled signals Nos. 5 and 6 Off and then stood with one hand on the economiser button, to pull No. 14 points. He heard No. 5 signal slide go back and within a few seconds Walmsley pulled Nos. 14 and 15 point slides. He said that although he had his back to him he could tell what he was doing. He turned round expecting to make a book entry, but when he again looked round almost all track circuits on the signalbox panel were showing occupied, and track circuit No. 7095 was flashing on and off intermittently. He asked the signalman the cause of it and Walmsley replied that he did not know but if the telephone rang he would answer it. He said Walmsley did nothing except look at the panel until the guard telephoned from Signal No. 5.

22. I questioned him whether either he or Walmsley had left the signalbox or gone behind the frame at any time and he said that they had not. Nor had he seen anybody around the signalbox although it was dark outside and they had the signalbox lights on. He was 55 years old, had been a train recorder for 3½ years, prior to which he had served 4 years as a Motor Driver.

23. *Area Maintenance Engineer J. H. Taylor* inspected the EMU passenger train after the accident. He told me that a supply motor generator brush arm had had to be replaced on 13th May, but in all his tests he found nothing that could have produced any unusual surge of current into the rails. He thought that the maximum current that could be taken was 246 amps. He also told me that Penistone Electrical Control had confirmed that there had been no voltage or current surge on the A.C. supply line, and the Central Generating Board had also said that there had been no voltage disturbance at the time of the accident. He had also had the profiles of the wheels checked on the recording machine at Reddish which showed slight wear of not more than 3/16 inches on the treads and almost nothing on the flanges. There were no unusual marks on any of the wheels and the treads were very clean.

24. *Permanent Way Supervisor S. S. Qualters* of Guide Bridge last examined the track on Monday 18th May at which time he checked the gauge of No. 14 points and found it to be correct. He walked through on the Up Fast line towards Fairfield and spent about 15 minutes checking the junction and its fastenings. He found nothing loose and everything in order. He also examined the junction after the accident and found no marks at all on the facing point switches in the Up Fast line and he told me that to him it was inconceivable that a train could have split the points and done no damage.

25. *Signal and Telecommunications Supervisor F. E. Buckland* of Guide Bridge was advised of the accident at 23.15 and arrived on the site of the accident at 23.35. He found points Nos. 14a, 14b, and 15 reversed but points No. 13 were under the rear car and he could not see them. He told me that points No 14a were not damaged and this and the fact that there was only one wheel mark on the sleepers in the 4 foot of the crossover surprised him. He assumed from this that the other wheels of the bogie had been in mid-air at the time. He also saw that the track circuit isolating fuses situated under the bridge in the tenfoot between the Up Fast and Down Slow lines had been run over and damaged by the middle car. He looked at the point control valves and they were intact, the covers were on and there was no sign of tampering. He then went to the signalbox by car and found slides Nos. 14 and 15 reversed in the frame, and all the track circuits indicating Occupied on the panel because of the damage to the isolating fuses.

26. *Acting Outdoor S & T Assistant J. Shawcross* arrived at the signalbox at 00.28 and also observed slides Nos. 14 and 15 reversed. He examined the electric lock at the back of the frame on points slide No. 14 and the cover was on and the brass padlock securing it was fastened in place.

27. *S & T Supervisor K. G. Birchenough* arrived at the signalbox at 00.30 and also found the slides Nos. 14 & 15 reversed and thought No. 13 was Normal. He told me that when he asked Walmsley what had happened Walmsley replied that he was waiting with his finger on No. 14 slide economiser button with No. 7120 track circuit occupied when No. 7121 was occupied and 7120 cleared. He then pulled the slide and the accident had occurred. When I questioned him he was adamant that Walmsley had told him that he had seen track circuit 7120 on the signalbox diagram showing clear, and 7121 occupied before he pulled the slide.

28. *S & T Technician E. R. Clark* was the senior maintenance technician at Guide Bridge where he had been employed for about 15 months. He described the AC track circuits to me and told me that he had not had to make any adjustments to the variable capacitors on any of the track circuits at Audenshaw Junction since the summer. He had inspected and tested them about 3 weeks before the accident and had found nothing wrong with them, nor with the oil-filled traction current impedance bonds, which he had fully checked. He had also checked the point control valve racks and found all in order.

Tests on the Signalling Equipment

29. From the foregoing evidence it is clear that No. 14a facing points moved from the Normal to the Reverse position between the bogies of the middle car of the train, so that the leading car remained on the Up Fast line whereas the rear power car crossed over to the Up Slow line and the middle car was derailed between them. It is also clear there was no mechanical failure of the point-operating mechanism since all was found in order after the accident, and there was no damage to the points. Tests were therefore carried out to discover how the points could have operated with twelve axles short-circuiting track circuit No. 7120, the occupation of which should have been locking them. The following possibilities were tested separately:

a. Faults in the electric or mechanical locking in the signalbox.

b. A false feed onto the track repeating relay (No. 7120 TPR) in the relay room (which is normally energised by track circuit No. 7120 TR) with 7120 TR de-energised.

c. A combination of faults and false feeds which would cause the track circuit relay (No. 7120 TR) to operate with the track circuit occupied.

d. A fault in No. 7120 TR itself.

e. A combination of faults and false feeds which would cause the points to be operated with 7120 TR de-energised.

f. The vulnerability of the alternating current track circuit to electrical transients of short duration but of high voltage, which might cause the relay to operate momentarily even with the track circuit occupied.

g. The vulnerability of the track circuit to 50 Hz or other alternating "ripple" voltages remaining superimposed on the 1500 volts direct current traction supply after transformation and rectification from the industrial alternating current source from which it was supplied.

30. The tests which were carried out are summarised in Appendix A. Although a few minor items were found, nothing that could account for the failure was revealed. Neither the slight damage to the 48 core cable nor the conditions of the traction bonding impaired the correct functioning of the signalling equipment and I am convinced that no signal failure occurred. Additional tests were still continuing when further evidence came to light as a result of which I took the following evidence from a number of signalmen and technical staff.

EVIDENCE CONCERNING EVENTS SUBSEQUENT TO 2ND OCTOBER 1970 TAKEN AT INTERVALS ON 3RD NOVEMBER 1970 AND LATER

31. *S & T Technician E. R. Clark* was sent to Stockport Junction signalbox on about 2nd October to deliver wiring diagrams to the relay room and to change some lamps on the block shelf. He told me that on arriving at the signalbox he went straight to the relay room behind it and was surprised when Signalman Walmsley came down there and began questioning him about the equipment. Walmsley then returned to the signalbox and Clark later followed him. He said that before changing the lamps and while standing near the signalbox door he saw Walmsley pull slide No. 30 fully reverse and then replace it to the mid position. Surprised, he asked Walmsley why he had done it and Walmsley replied that it enabled him to beat the approach locking of the points. (No. 30 points are approach locked when track circuit No. 7176 is occupied until 60 seconds have elapsed). He understood from Walmsley that he did this when he was not certain of the destination of the next train and it allowed him to move the points immediately the driver telephoned him from the signal, instead of having to wait the full release time. (The points are shown in Fig. 3).

32. Clark then told me of a second occurrence on 19th October concerning No. 18 trailing points. He and his assistant had been sent to the signalbox where Walmsley complained that he could "pick" No. 18 points slide thus putting the dog of the electric lock out of its notch. Walmsley demonstrated this when an electric multiple-unit train was approaching. Clark told me that having seen from the signal indicators that the two signals had been replaced to Danger by the train, he watched the track-circuit indications on the signalbox diagram and about two seconds later Walmsley pulled the points slide (which should have been track-circuit locked) to the 'B' position and remarked that if he pulled the slide to the full reverse position the train would run through the points and damage them. Clark then said to him "You are fiddling John" because he was disgusted by his behaviour. On both occasions he had reported the incidents.

33. I questioned *S & T Technician N. Pennington* who was Clark's assistant regarding the events of 19th October and he confirmed Clark's statement. He said he was standing near the signalbox door and was watching the line at the time of Walmsley's demonstration but heard the slide movements. In his opinion the train was well clear of the points when Walmsley reversed the slide, but he was sure that the slide was free of the locking when the train was on the points. He heard Clark say "You are fiddling John" and he told me that Walmsley replied "No I'm not, I'm just proving that you can make this move". Pennington also reported this incident.

34. Pennington said he had never heard of this irregular use of points slides before but he did know of an irregular use of signals slides involving the feeding of one signal from another which, he said, was common knowledge. He told me that he had seen it done by a signalman many years ago (he thought it was at Hyde Junction Signalbox), and possibly on another occasion since then. He had warned the people concerned that it was an illegal move. He had not heard of Walmsley using this move, except that there had been much talk of it during the week prior to my interviewing him. Pennington told me he had been an S & T Technician in the area since the new signalling was installed in 1953 and for much of that time at Gorton and Guide Bridge.

35. *R. H. Blyth Assistant Divisional S & T Engineer* acting on information received from Clark and Pennington carried out certain tests in Stockport Junction signalbox on 19th October. *Signalman W. Allman* was on duty and *J. Shawcross* the Acting Outdoor S & T Assistant was also present. He began his tests soon after 22.30 and he first checked that slide No. 18 could be moved with track circuit 7152 occupied if the electric lock dog was first put onto the top of the slide by pulling the slide partly out of the frame. He then decided to check once again that it was not possible to irregularly operate slide No. 14 (that involved in the accident on 20th May 1970) through normal working with signal No. 5 Off. He first pulled slide No. 14 until the electric lock dog was on top of the slide, and simulated the approach of a train by "dropping" track circuits in sequence, and then tried to pull signal slide No. 5 which was locked, because the electric lock dog of slide No. 14 was not home in its notch. Similarly, with slide No. 5 pulled to the Off position he could not move slide No. 14 which was mechanically locked, and he once again showed that it was not possible to replace No. 5 slide and pull slide No. 14 quickly before the approach locking could take effect.

36. He told me they were discussing the position with the signalman when Allman obtained a Line Clear Block Release from Ashton Junction so releasing signal slide No, 6. Mr. Blyth told me that at Allman's suggestion he pulled slide No. 6. and was trying to manipulate slide No. 5 with slide No. 14 pulled slightly out

of the frame with its electric lock dog on top of the slide, when Allman placed the signalbox electric Bardic handlamp across the economiser terminals of slides No. 5 and No. 6 and said "Try That". (This is shown in figure 1 at the front of this report).

37. After some manipulation he managed to clear both signals with slides Nos. 5 and 6 reverse and slide No. 14 slightly out of the frame. He asked his lineman to drop track circuit No. 7120 which should have automatically replaced slide No. 5 but it did not do so. He told me that he was amazed at this and asked Shawcross to go behind the signalbox frame to check that the 'LCC' contacts on slide No. 14 (known as the butterfly contacts) were actually broken, and both he and Shawcross checked that they were. (The breaking of these contacts should have prevented signal No. 5 showing a clear aspect). After some experimenting he discovered that immediately the Line Clear Release (on slide No. 6) was removed, or the hand lamp removed, Slide No. 5 was replaced automatically and the signal was replaced to Danger. He repeated the tests several times, and left the signalbox at about 00.30 but said nothing to signalman Allman at the time.

38. Mr. Blyth told me that he had been Assistant Divisional S & T Engineer for nearly 4 years and had never in that time heard of such malpractices, but he now realised that there were several signalboxes in the area where they could be carried out.

39. *Acting Outdoor Assistant J. Shawcross* confirmed Mr. Blyth's statement. He told me that Allman said "get the slot (Line Clear Release) from Ashton Junction, pull No. 6 slide to the Off position, and then put No. 6 back". (The false feed condition was not destroyed on replacing No. 6 slide because the Line Clear Release is of the one-train-only variety). Allman then took the hand lamp and placed it across the two economiser contacts. I asked him if before this happened Allman had been on the telephone to anyone, and he replied that he had not been because Allman had been sitting down while the testing had been going on, but he had been on the telephone earlier in connection with his normal signalling duties.

40. I questioned *Signalman W. Allman* on how he had known on 19th October what to do to clear signal No. 5 with No. 14 slide partly out of the frame and he told me that he had heard it from Signalman Davies earlier that evening over the telephone. Allman told me that he believed certain signalmen must have known about it for some time. Davies, who had once been his relief signalman at Stockport Junction, was on duty on 19th October at Dewsnap signalbox. Davies had telephoned his (Allman's) train recorder in Stockport Junction and had asked to speak to him, but Allman told me that he was not able to take the full message then because signalbox work intervened, but he later telephoned him back and he had repeated to Mr. Blyth word for word what Davies had said. Allman also told me that he had never heard of such malpractices before.

41. I visited the signalbox on 27th October and watched the irregular moves that I have described being demonstrated. I was particularly interested to know if, by carrying out these moves, there was any "click" when track circuit 7120 was cleared by a train, and during a simulated test I confirmed there was none. I also searched the signalbox for pieces of metal that could have been used to short-circuit the two contacts concerned, and in addition to the hand lamp I found a broken hinge about 5 inches long behind the Block instruments at the right hand end of the frame, and there were also the usual hand tools for the combustion stove. I was told that the stove had been replaced since the accident, but that similar tools had been provided for the old stove. During tests however, the lamp was the easiest to use because it stayed across the terminals by its own weight and did not have to be held.

42. *Relief Signalman G. Davies* was on duty in Dewsnap signalbox during the tests in Stockport signalbox on the evening of 19th October. He confirmed that he had telephoned Allman that night and went on to tell me how he had first heard of the malpractice. He was relief signalman at Guide Bridge East signalbox on 1st September 1970 when, at about 13.30 he was offered an electric multiple-unit train on the Down Fast line (bell code 3.1.2) from Hyde Junction signalbox. He offered the train to Ashton Junction signalbox and it was accepted and as the train passed he sent "Train Entering Section" in the usual way. He was next expecting a freight train (bell code 3.2) on the Down Fast line almost immediately, and he was surprised when after a delay of some 8 minutes a Rose Hill to Piccadilly diesel multiple-unit train (bell code 3.1) arrived instead. He had already offered the freight train forward and he therefore telephoned Ashton Junction signalman that he must have made a mistake, and he sent "Train Entering Section" for the DMU when it passed his box. A few minutes later he was even more surprised to find the freight train standing at his Home signal. He told me that on telephoning Hyde Junction signalbox the early turn signalman replied "Its alright mate" and replaced the telephone receiver. After several attempts to phone back he spoke to the late turn signalman who said "I'll explain to you in a minute, I've got my mate here but you are quite alright now I have straightened it all out". Davies told me that after he had cleared the freight train in the normal manner the late turn signalman telephoned back and told him that the early turn signalman had a poker placed across the 'mouse trap' contacts and the signals were maintained Off down the Main line. The signalman told him that on coming on duty at Hyde Junction he had seen the DMU standing at the Starting signal which he saw clear to a Green aspect, and as he was walking up to the signalbox Ashbury's freight train also came past under clear signals, and on entering the signalbox he saw the poker across the terminals. Davies told me that he had been so taken by surprise that he failed to send "Obstruction Danger" to Hyde Junction, and that when he realised it was his duty to do so the dangerous situation had been cleared.

43. Davies also said that he had worried about the method used by the signalman at Hyde Junction to get themselves out of trouble and had passed the information on to Allman on 19th October when he knew that signalbox tests were in progress, in case it might be of value.

44. He told me that he had trained with Walmsley and he had also on occasions worked for 20 minutes or so in the same signalbox before Walmsley had gone home. He had never seen Walmsley or any other signalman operate the points slides so that their electric lock dogs were out of their notches.

45. *Signalman J. L. Fletcher* was the early turn signalman at Hyde Junction signalbox on 1st September 1970. When interviewed on how he came to place the poker across the signalframe shorting across the "mouse trap" terminals he said that he was attending to the stove when Woodley signalbox called his attention. He went to the block shelf to answer the bell and placed the poker which was still in his hand on the frame. He then ran the electric multiple-unit train (block bell code 3.1.2) on the Down Main line followed by the diesel multiple-unit train (bell code 3.1) from the Down Branch. Following this he lowered his Home signal to allow the freight train (bell code 3.2) down to his Starting signal but this signal was irregularly cleared and this train also entered the section.

46. Fletcher was pressed by railway officers as to whether he had not deliberately placed the poker across the terminals because he had decided to alter the sequence of trains, but he denied this. It was pointed out to him that if his explanation was accepted, he had failed to carry out Train signalling Regulation 22 in that he did not send block bell code 4.5.5., "Train Running Away in Right Direction"; nor had he reported the incident at the time, and he admitted that this was so. He had been a signalman since 1951, had worked as a relief signalman based on Denton, Greenfield and Woodley until April 1970 when he took charge in his present post at Hyde Junction signalbox.

47. *Junior Railman R. S. Sparkes* had worked as relief train recorder in Stockport Junction signalbox when Walmsley was on duty. He told me that he had seen Walmsley pull points slides No. 30 partly out of the frame on at least two occasions before a train occupied the approach locking track circuit, in order to defeat the time release. He had also seen him do the same with signal No. 35 which involved Nos. 8 & 9 points slides, but as it was a shunting move the train did not pass over the points. He told me that he had never seen him partly pull No. 14 slide out of the frame, but he had seen him do it with No. 18 points with a train on the line, although Walmsley was looking at the signalbox diagram and did not pull the points slide until after the train had cleared the junction.

48. He told me that he had never seen any signalman use anything metallic to false feed a slide in Stockport Junction signalbox but he had seen a lamp used to false feed signal slide No. 45 in Ashton Junction signalbox shortly before the accident occurred in May 1970, and he thought that it was to signal an engine from the Slow line into the Cabin siding.

49. Because *Temporary Railman G. H. Widdows* was the train recorder in Stockport Junction signalbox with Walmsley at the time of the accident, I interviewed him again on 3rd November and he repeated everything that he had said before. I questioned him particularly on whether there was a signal lamp on the frame behind slides Nos. 5 & 6 when Walmsley had pulled them to clear the two signals for the passenger train, and he said that it was definitely not used, nor did he see anything in Walmsley's hand. (Walmsley had been at the other end of the signalbox shortly before he cleared the two signals and Widdows had been making an entry in his book at the time). He told me he saw No. 5 slide go back in the frame and saw Walmsley pull Nos. 14 & 15 points levers with his left hand on the economiser button. (When I had questioned him on this point at my Inquiry he had said that although Walmsley had his back to him he knew what he was doing). Finally, when I asked him how he could be sure Walmsley's hand was on the button for No. 14 slide and not on that for No. 15 slide, he said he could not be certain, but that he did have his left hand on one of the buttons, and also that when he pulled the slide the freight train had partly passed the signalbox.

50. *Mr. F. W. G. Smith*, the Divisional Signal and Telecommunications Engineer upon whom the whole burden of the signalling tests had fallen, was present at my Inquiry and the subsequent interviews. When questioning Widdows on 1st September, he remembered finding the original stove's poker behind the signal frame on the day after the accident. He had thought then that it might have been used to lift the electric lock dog on slide No. 14 but he had found it to be too thick. He now realised however, that it might have been a suitable object by which the false feed could be applied.

51. Mr. Smith at my request questioned all his technical staff on whether they had visited the signalbox on the night of the accident and of those who did, whether they had found the relay room door open or shut. None of them could remember opening the door and I must assume that one of them did so automatically and that it was closed at the time of the accident.

CONCLUSIONS AND RECOMMENDATIONS

52. The accident was caused by facing points No. 14 moving under the middle car of the electric multiple-unit train. I am satisfied that this was not the result of any failure of the signalling equipment. The tests carried out by the London Midland Region were completely comprehensive and thorough, and I believe that neither the slight damage to the 48 core cable nor the condition of the traction bonding impaired the

correct operation of the signalling equipment, and could not either of themselves or together have caused the points to move.

53. I believe that the points were moved by Signalman Walmsley who in doing so committed two gross irregularities. Firstly he seems to have been in the habit of pulling his points slides slightly out of the frame in order to release them from their approach locking, for he had been seen to do this with points No. 30 by both Clark and Sparkes, and the latter had seen him do it with Nos. 8 & 9 points also. At the time of the accident Walmsley had signalled a freight train down to signal No. 34 protecting Audenshaw Junction on the Down Slow line. He had also accepted the passenger train on the Up Fast line, and by his own evidence was keen to reverse the points as soon as possible to allow the freight train to cross onto the Down Fast line behind the passenger train. Had he not had the slide free of its electrical locking, the occupation of track circuit 7156 by the freight train which was already passing his box would have prevented him moving the points until the time delay had run out.

54. Having pulled the points slide slightly out of the frame he had to commit a second and more serious irregularity in order to clear the signal. This is because the signal can only show an Off indication when the points lock dog is properly in the slot in the slide, and it was not possible for him to clear No. 5 signal except by false feeding the lock through the economiser contact from slide No. 6, and I am satisfied this is what he must have done. In normal working there was no reason why he should not have cleared signal No. 5 and allowed the train up to signal No. 6 until he had obtained a Line Clear Release from Ashton Junction signal-box for it. That he chose to hold the train at signal No. 5, and then pull both signals Off together is indicative of unusual working. Guard Malik thought that signal No. 5 was still showing Green when his compartment passed it which would have been the case had the signal been irregularly cleared and its replacement to Danger prevented by the false feed. S & T Technician Pennington believed that many signalmen had known how to false feed signal slides for many years (although the exposed "mouse trap" terminals date back earlier to when the original all-pneumatic installation was converted to an electro-pneumatic one) and that it was common knowledge amongst them. Indeed he had seen it practised on one or two occasions, and so had Junior Railman Sparkes. For this reason and because of the failure to send a "Train Running Away" bell signal or to report the incident I cannot accept Signalman Fletcher's evidence that the placing of the poker across the signal slide economiser (mouse trap) terminals in Hyde Junction signalbox on 1st September 1970 was unintentional, and I also believe that it was intentional in Walmsley's case. The finding of the old poker and the broken hinge behind the shelf above the signalbox frame supports this view, and I think that the latter item could have been used without Widdows noticing it. The false feed could not be put on slide No. 5 until after the Line Clear Release had been obtained, and No. 14 points slide could not be pulled fully reverse until slide No. 5, which is mechanically interlocked with it, had been fully replaced on the removal of the false feed when the train was occupying track circuit 7120. I cannot accept that an accidental false feed would have been first made and then removed at exactly the right moments to cause this derailment, and despite Walmsley's evidence I am satisfied that it must have been a deliberate act by him. Walmsley's own evidence also varied. He told Mr. Birchenough when he visited the signalbox soon after midnight on the night of the accident that he had been watching the track circuit indications on the signalbox diagram when he pulled slide No. 14, but to me he said that he had not been watching them but had been waiting for the click of the lock. The former is more likely to be the case.

55. Many controls are not proof against deliberate irregularity, and the very high standard of safe signalling on the railways has been achieved not only by the skill, but by the integrity of signalmen. By his demonstration on 19th October of his ability to move points No. 18 when a passenger train was actually traversing them Walmsley showed that he did not have that integrity.

56. There is no evidence however to suggest that Walmsley intended to do anything other than speed the flow of traffic, and I do not for a moment believe that he derailed this train intentionally. When standing at No. 14 points slide he could easily see the signalbox diagram and the separate illuminated track circuit indications are easy to define. There may have been a 'click' in the frame that led him to believe that track circuit 7120 was clear, though I was unable to make one occur, and I think it is more likely that he was inching the points slide out as the train proceeded and in error took the slide to the reverse check lock position at which it was automatically operated, and the points reversed. His delay in calling for the emergency services was reprehensible and I can only assume that it was caused by shock following his realisation of what he had done. Nor did he make use of the special "Electrification Telephone" provided in his signalbox and connected to Penistone Electric Control to have the electricity cut off in an emergency.

57. In operating his points slides so that they were free of approach locking, Walmsley may have believed that he was not committing a gross irregularity. This locking is provided in cases where signals are close to the points they protect, to minimise the possibility of a train reaching the points while they are still in mid-stroke. Many older signalboxes do not have such locking, and indeed in the most modern ones approach locking is only applied to trailing points and not to facing points such as No. 14 points, which lie within the overlap of a signal. In this instance however, in freeing himself of the approach locking Walmsley was also removing the locking imposed by the presence of the train on the points themselves and this, by his own evidence, he knew.

58. To clear a signal irregularly when the route ahead through points is not fully secured (the slides or levers as well as the points themselves must be locked in the required position) is a much more serious matter. The fact that several signalmen have in the past so cleared their signals, but have not reported or admitted it until closely questioned long after a serious accident has occurred, points to a lamentable state of discipline amongst those signalmen, which in turn suggests that the supervision in the signalboxes concerned has not been sufficiently thorough. The irregularity might have come to light sooner had the signal technicians, and especially Pennington who had commented on it to the signalman concerned, reported it even in general terms, to their superiors, and this also applies to Junior Railman Sparkes.

59. Guard Malik carried out his protection duties well, and I particularly commend his use of the track-circuit operating clips and the signalpost telephone which, with the signalling installed, offer the best means of protecting the railway. I consider that he could have telephoned the signalman a little sooner (he only did so some 10 minutes after the accident; but he only had to walk some 185 yards to the signal which could not have taken him 2 minutes) and in my opinion having seen the middle car on its side, he should also have asked for the electricity to be cut off then, instead of waiting until he visited the signalbox.

60. Driver Greenwood also failed to ask the signalman to have the electricity cut off when he visited the signalbox although he had already seen the middle car lying on its side and must have known that some passengers were trapped. There was also an electrification telephone beside the Down Fast line at Stockport Junction, and had he known of it he might have thought of using it.

61. Paragraph 10 of the British Railways Working Instructions for AC Electrified Lines 1967 states:

> "Any person becoming aware of a derailment . . . . likely to require the electricity to be switched off, must immediately telephone . . . . or arrange for this to be done."

The Manchester Sheffield Wath D.C. electrified lines are worked by similar instructions issued jointly by the Eastern and London Midland Regions in 1954, of which paragraph 38 reads—

"In emergency, any member of the Railway Staff . . . . may ask for electricity to be switched off . . ." I consider that the latter instructions fail to imply the degree of urgency of the former, and this may have contributed to the delay in rescuing the passengers, most of whom were injured, from the middle coach. I am glad to be able to report that the two Regions have agreed to suitably amend the paragraph.

62. There are 10 similar signalboxes in the Manchester area on the Manchester-Sheffield-Wath lines which were vulnerable to the malpractices described. I am glad to be able to report that immediately they came to light London Midland Region taped all unprotected terminals on the signal slide economiser units, and all the frames have since had boxing placed over the slides to prevent false feeds occurring either intentionally or unintentionally. To prevent signalmen pulling points slides out so that they are left free of their electric locking is more difficult, but as soon as this malpractice came to my attention I informed the Chief Inspecting Officer of Railways who gave details of what had been taking place to the appropriate Chief Officers at British Rail Headquarters so that other Regions with similar equipment could be put onto the alert against it.

63. Signalmen are forbidden to replace to Danger a signal protecting a junction until the last vehicle of a train has cleared the junction points, as stated in British Railways Rule Book Rule 68. This rule was made because when applied the mechanical locking between the signal lever in the Off position and the points levers prevent the latter being moved under a train. The signalling at Stockport Junction however utilises track circuits to hold the points, and the signals are automatically replaced to Danger before trains are clear of the points they protect.

64. Track circuits have not always been successful in preventing points moving under trains, and the accident at Bold Colliery near St. Helens on 29th December 1965 and that at Whitton Junction in the Southern Region on 18th August 1967 (See Chief Inspecting Officer of Railways Report for that year page 51), are cases in point. In this accident, Railway Signal Engineers have spent much time and effort in thoroughly testing the track circuit and control equipment because they were aware that combinations of faults could, rarely, result in their failure.

65. Automatic replacement of a signal slide or lever as a train enters the junction removes, at the worst moment, the back up mechanical locking which is already available in many signalboxes. However had the automatic replacement of the signal slide been actuated when the last wheel of the train had cleared the track circuit through the junction, the derailment would still not have been prevented because, on the removal of the false feed, the signal slide would still have been automatically replaced on account of the points slide not being fully home in the frame. Even if means could be found to overcome this (and it might involve duplication of many of the controls) the signalman had only to replace the slide manually to obtain the same result. The protection by boxing already referred to is therefore the most important of the two improvements required, but in view of the above I also recommend that in the ten signalboxes involved modifications should be carried out so that points slides cannot be pulled partly out of the frame to defeat the approach locking, incidentally

making the points they control vulnerable to the albeit rare occurrence of track-circuit failure. If such modifications prove to be impracticable, the automatic replacement of the slides of signals protecting junctions should be dispensed with.

I have the honour to be,

Sir,

Your obedient Servant,

A. G. TOWNSEND-ROSE,
Lieutenant Colonel.

The Permanent Secretary,
Department of the Environment.

APPENDIX A

SUMMARY OF TESTS ON SIGNALLING EQUIPMENT

1. *General Functional Tests and Site Examinations.* Track circuit No. 7120 was fully tested on three occasions following the accident, i.e. at about 11.00 on 21st May, 08.00 on 24th May, and 18.00 on 25th May. Prior to the last test a new track relay was fitted so that 7120 TR could be sent for examination. Some 20 separate readings were taken on each test and normal feed voltages of 3.8 to 4 volts (3.1 to 3.6 volts at the relay) and a relay drop-away voltage of 0.59 volts were recorded. When passenger services were resumed on the Up Fast line at 14.45 on 21st May the passage of each train was monitored and no incorrect conditions were noted. Following a close examination of the junction, two broken and two loose traction current bonds were found and these are indicated in Fig. 5 at the back of this report. It was also then discovered that the approach locking timing relay (14a JR, an AEI-GS thermal relay type EN 127) took 137 seconds to operate instead of the nominal 90 seconds. In all other respects, except for the damage caused in the accident, the junction equipment was found to be in good order.

2. *Equipment Tests.* All the relays connected with track circuit 7120 and the gravity lock from No. 14 slide; No. 14a electro-pneumatic valves and their transformer-rectifier sets, the circuit-breakers, and the point-operating cylinder itself were examined at the C S & T E laboratory at Crewe. I have studied the reports and I am satisfied that nothing untoward was discovered. The relays carried test labels dated 3.2.69 and 9.5.69 and were in good order. The gravity lock contained some dust, and only one of the lock detector contacts seemed to have been in use, but failure of any or all of the lock detector contacts to make would be a "safe side" failure, and the lock anyway was functioning well.

3. *Signalbox Tests.* A full circuit test was made in the signalbox and relay room and all the circuits involving signals Nos. 5 & 34 and points Nos. 13, 14, and 15, and many other circuits were fully tested, and examined for earth conditions and no fault could be found. Repeated tests with simulated and test trains proved conclusively that once point slide No. 14 became approach-locked by the occupation of track circuit No. 7095 the locking remained fully effective whichever way signal No. 5 slide was operated and replaced with respect to a passing train; until either the train had cleared track circuit 7120 or the full time cycle of 137 seconds from the time the treadle was operated had elapsed after No. 5 signal had been replaced to Danger. Nor was it possible to jump the lock dog on slide No. 14 out of its notch with the lock coils de-energised. Finally a recording voltmeter connected to this lock with the lock economiser button bridged, failed to detect any intermittent irregular energisation over several days recording prior to 8th June. During these tests the operation of slide No. 14 was timed and was found to operate automatically to completion of travel in either direction some 3 seconds after being pulled.

4. *Track Repeating Relay No. 7120.* While measuring the insulation of the 48 core cable between locations 4/32 and 4/45 an old cut in the sheath of the cable, (probably caused by a scythe when grass-cutting) was found adjacent to the outer layer containing cores 26–48 as shown in Fig. 3. (The 7120 TPR circuit was carried by 34 and 35 cores). The insulation resistance even after several days of dripping water into the cut never fell below 50,000 ohms which is more than adequate to ensure proper operation of the 'track-repeating' circuits concerned. These circuits are moreover 'double-cut', that is to say they have contacts which have to be made and broken in both the positive and negative side cables, and two false earths and false feeds would have to be made to operate them irregularly. No possibility of even one false feed was found.

5. *No. 7120 Track Circuit and Relay.* Following exhaustive tests and examination no wiring false feeds or false earths could be found. The cables to the track circuit were cut in the accident, but once these had been repaired functional tests showed no irregularity and examination of the relay itself showed it to be in a good condition. The relay drop-away shunt varied between 0.7 and 1.0 ohms across the rails which is satisfactory.

6. *Operation of the points motor with track circuit relay 7120 TR de-energised.* To false feed the reverse valve of the point control mechanism and throw the points fully reverse, three conditions would have to arise simultaneously:

a. failure of the positive 110 volts connection to the Normal valve control,

b. failure of the negative 110 volt connection to the Reverse valve control,

c. false feed of 110 volts onto the Reverse valve control.

No false feeds or broken connections were found.

7. *Momentary False Energisation of the Track Circuit.* Because of the lack of any indication of how the points could have been irregularly operated, exhaustive tests were carried out using trains to see if momentary transients of short duration or 'spikes' of electrical energy could be induced in the rails, and hence in the track circuit relay itself, sufficient to cause it to operate even momentarily. AC track circuits require an operating voltage to be present for a significant time for them to operate and in the relay used (7120 TR) this voltage was measured on 21st and 24th May as 0.88 volts at 50 Hz. It is known that under suitable conditions 'spikes' of very high voltage can sometimes be made to operate such relays momentarily, although 'spikes' of lower voltages and short duration fail to do so. On 24th May, 19 test runs were made using an electric multiple-unit train similar to that involved in the accident, and on 31st May and 7th June a further 12 and 9 tests were made using the leading and trailing cars actually involved in the accident. The rear car was in each case the power car, as in the accident itself. Observers were stationed in the signalbox, at No. 14 points, at relay No. 7120 TR and at the joint between Nos. 7120 and 7121 track circuits. For these tests the traction current bonds were disconnected as shown in Fig. 5. In all of them the relay performed satisfactorily and no 'spikes' capable of operating it even momentarily were detected.

8. Between 8th and 17th June the relay voltage continued to be monitored with normal traffic running and although 'spikes' of energy of 3.6 volts were measured with the track circuit occupied, and on one occasion a 'spike' of 5 volts, their durations were far too short to operate the relay which continued to function correctly.

9. During the tests made with electric multiple-units starting away from signal No. 5, timings were taken from the moment the signal cleared until the leading bogie of the middle car was just over the points. Timings of from 23.5 to 27.5 seconds were obtained which indicate that the train would be travelling at some 25 m.p.h. when the points moved. Tests showed that the maximum 'spikes' of energy occurred as the power unit automatically switched from 'series' to 'parallel' running with an instantaneous current peak of 900 amps, but even with the shorter timings and ignoring the 3 seconds required to operate the points these peaks occurred when the train was well before the junction. The 'parallel' to 'weak-field' switching occurred as the train was astride the points, but the peak amplitudes obtained were negligible. Thus even supposing a significant peak was induced by the train (and there was no evidence to suggest there was) it is, even so, not likely to have done so at the time the points were moved.

10. During the tests on 31st May the DC traction supply, which was monitored, was seen to have a 300 Hz ripple of 1.5%, i.e. 75 volts peak to peak, but no 50 Hz component would be detected. In the remaining tests the track circuit relay control coil voltage was monitored and the 300 Hz ripple was detected. No appreciable energy reached the relay from this source and the relay functioned correctly throughout.

11. Finally static tests using up to 13 volts D.C. intermittently applied across the rails under various conditions of shunt, disconnection, etc., failed to cause the relay to operate. Tests were also made with track circuits on the Down Slow line involving points 14b but it remained impossible to cause any malfunction of any of the relative relays.

Printed and published by
HER MAJESTY'S STATIONERY OFFICE

To be purchased from
49 High Holborn, London, WC1V 6HB
13a Castle Street, Edinburgh EH2 3AR
109 St Mary Street, Cardiff CF1 1JW
Brazennose Street, Manchester M60 8AS
50 Fairfax Street, Bristol BS1 3DE
258 Broad Street, Birmingham B1 2HE
80 Chichester Street, Belfast BT1 4JY
or through booksellers

Printed in Scotland

SBN 11 550212 2

DERAILMENT AT AUDENSHAW JUNCTION ON 20th MAY 1970.

FIG. 4 LOCATION PLAN

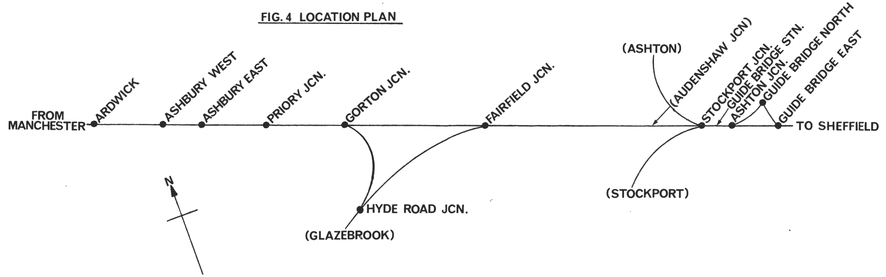
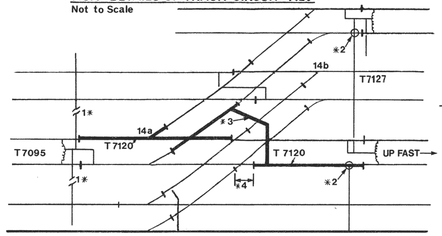


FIG. 5 DETAILS OF TRACK CIRCUIT 7120

Not to Scale



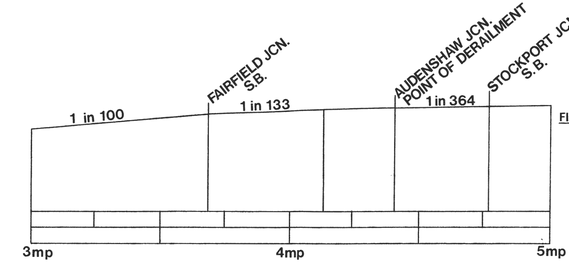


FIG.6 GRADIENT DIAGRAM

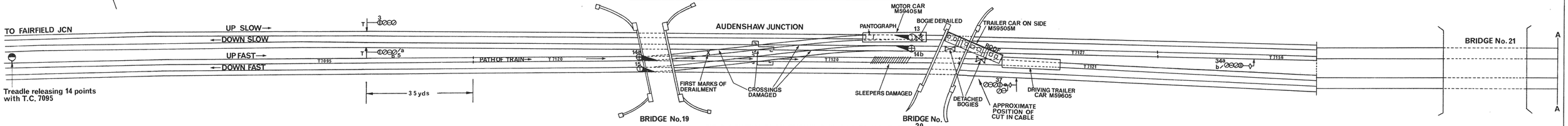
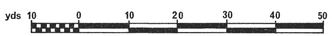
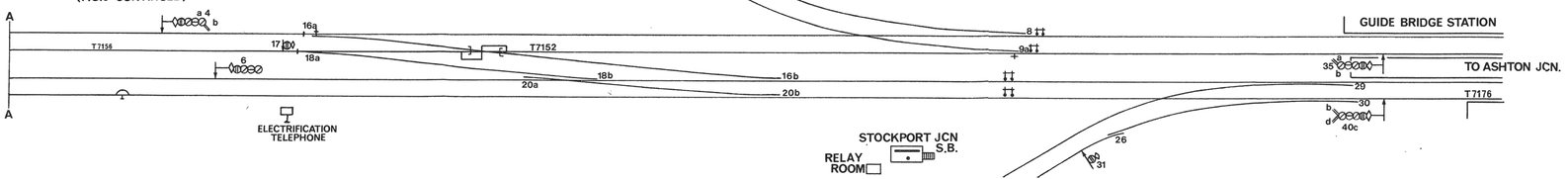


FIG. 3 GENERAL PLAN SHOWING SITE OF DERAILMENT



(FIG.3 CONTINUED)



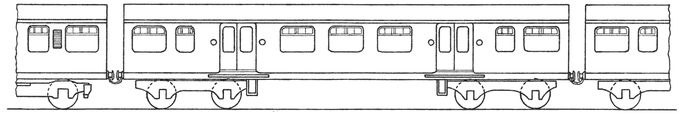


FIG.7 CENTRAL CAR COMPOSITE TRAILER M59505M